hope, he apprehends, must be relinquished of ever effecting the decomposition of the muriatic acid in the way of simple elective attraction; its basis being probably some unknown body, which nothing but the application of complicated affinities will perhaps ever enable us to discriminate.

On double Images caused by atmospherical Refraction. *By* William Hyde Wollaston, *M.D. F.R.S.* Read March 6, 1800. [*Phil. Trans.* 1800, *p.* 239.]

The remarkable instances of double and triple images of the same object produced by aerial refraction near the horizon, lately communicated to the Society by Mr. Huddart, Prof. Vince, and Mr. Dalby, have given rise to the present paper, in which the author attempts to explain these phænomena on theoretical principles, and to illustrate his conclusions by artificial experiments.

Admitting the inference given by Professor Vince, that these appearances arise from certain *unusual variations* of increasing density in the lower strata of the atmosphere, our author undertakes, 1st, to investigate the successive variations of increasing or decreasing density to which fluids in general are liable, and the laws of the refractions occasioned by them; 2dly, to illustrate and confirm the truth of this theory by experiments with fluids of known densities; and lastly, to ascertain, by trial upon the air itself, the causes and extent of those variations of its refractive density on which the inversions of objects and other circumstances observed in the above phænomena seem to depend.

Under the first head we find the demonstrations of three propositions, deduced from the general laws of refraction. The first imports, that if the density of any medium varies by parallel, indefinitely thin strata, a ray of light moving through it in the direction of the strata, will be made to deviate during its passage; and the deviation will ever be proportionate to the increment of density where it passes. From the second it appears, that when two fluids of unequal densities are brought into contact, and unite by mutual penetration, if the densities at different heights be expressed by ordinates to a perpendicular line drawn across the fluids, the curve drawn through the terminations of these ordinates will have a point of contrary flexure. And in the third proposition it is shown, that if parallel rays pass through a medium, varying according to the preceding proposition, those rays above the point of contrary flexure, where the line will be concave, will be made to diverge, while those below the same point, where the curve will be convex, will converge after their passage through it. The converging rays, it follows hence, will at a certain distance, proportionate to the quantity of convergency, meet in a focus, beyond which they will diverge again, and thus produce effects perfectly similar to those caused by a medium of uniform density, having a surface similar to the above-mentioned curve of densities, whether convex or concave, according to the nature of that curvature. Hence may be inferred

the manner in which, according to this theory, an object viewed through a medium of various densities, producing or rather represented by a curve of contrary flexure, and at the same time a contiguous stratum of uniform density, will exhibit three different images; the one through the uniform medium, in its proper place; the other through the convex part, somewhat higher, but inverted; and the third refracted by the concave part, still higher, erect, but somewhat smaller.

Grounded upon these principles, Dr. Wollaston proceeded next to the set of experiments which are the subject of his second section. The first and most explanatory of these experiments was made with a square phial, about one-third filled with clear syrup, and the other third with pure water, the two liquids forming by degrees, at the plane of contact, a thin stratum of decreasing density from the syrup upwards. Here the effect was obviously conformable to the theory,—an object viewed through these media being represented to the eye, erect and in its proper place when seen through the syrup of uniform density; higher and inverted behind the adjacent variable medium; and still higher and erect behind the upper part of the variable stratum. This effect of varied density was repeated by filling the remainder of the phial with spirits of wine; when at the plane of contact between the spirit and the water, another variable stratum was gradually produced, which exhibited the same phænomenon as in the former instance.—The next experiment proves that a difference of temperature between adjacent strata of the same fluid will produce the same effect.—And a third experiment, which may be considered as a corollary, showed that the air round a heated body (a red-hot poker for instance,) will assume the same varied densities, and exhibit precisely the same appearances.

Under the third head the author observes, that though three images have as yet been rarely seen in the atmosphere, yet this circumstance does by no means invalidate the above theory; since its appearing so seldom may be well accounted for by the less rarefaction produced by the heat of the sun, than by a red-hot iron, or the artificial means above used. Over water, the evenness of the surface, he says, is favourable to the production of such appearances.

Some observations are, lastly, added concerning Mr. Huddart's opinion, that the peculiar state of the atmosphere which produced the appearances he witnessed may have been occasioned merely by the evaporation at the surface of the sea condensing the lower strata of the atmosphere. Dr. Wollaston does not altogether accede to this opinion; but he does not absolutely deny that the cold produced by this evaporation may in some instances occasion a density that may enter as one of the data in the theory above laid down, though other causes, such as the effects of the heat of the sun, currents of air, &c. he thinks must co-operate. To the density, however, produced by mere evaporation, he acknowledges may be ascribed the uncommon elevation of the coast of France, lately observed at Hastings by Mr. Latham; and some of the appearances described by Professor

Vince. The depression of the horizon, frequently noticed by persons residing near the sea, and some other phænomena of a similar nature, he thinks may likewise be ascribed to that single cause.

On a new fulminating Mercury. *By* Edward Howard, *Esq. F.R.S.* Read March 13, 1800. [*Phil. Trans.* 1800, p. 204.]

We learn from the introduction to this paper, that mercury, and most, if not all, its oxides, may, by treatment with nitric acid and alcohol, be converted into a crystallized compound, possessing all the inflammable properties of gunpowder, as well as many others peculiar to itself. After stating the gradual steps by which he arrived at this discovery, Mr. Howard describes the following process and manipulations, which he found best calculated for producing this powder.

One hundred grains, or a greater proportional quantity, of quicksilver, are to be dissolved with heat in a measured ounce and a half of nitric acid. This solution being poured cold upon two measured ounces of alcohol, a moderate heat is to be applied, until an effervescence is excited. A white fume then begins to undulate on the surface of the liquor, and the powder will be gradually precipitated upon the cessation of action and re-action. This precipitate is to be immediately collected on a filter, well washed with distilled water, and carefully dried in a heat not much exceeding that of a water-bath. This immediate edulcoration of the powder is material, it being liable to the re-action of the nitric acid, which, while any of that acid adheres to it, renders it subject to the influence of light. The quantity of the powder produced varies according to the nature of the ingredients; 100 grains of quicksilver yielding from 120 to 132 grains of the compound.

The principal agents which decompose this mercurial powder are the nitric, the sulphuric, and the muriatic acids. The most remarkable effect is that of the sulphuric acid, which, when much concentrated, produces an explosion nearly at the instant of contact, on account, it is thought, of the sudden and copious disengagement of the caloric. When the acid is less concentrated, no explosion takes place; but a considerable discharge of gas, as well as caloric, is nevertheless effected; the former appearing to be a compound of carbonic acid and a peculiar inflammable gas, amounting in the whole to between 28 and 31 cubical inches. The inflammable gas was upon close examination found to be a nitrous ætherized gas, which appears to have been not the result of the decomposition, but, in fact, a constituent part of the powder.

Upon the whole of the investigation, Mr. Howard concludes that this mercurial powder is composed of nitrous ætherized gas, and of oxalate of mercury with excess of oxygen. Having stated his reasons for maintaining this opinion, he goes on to explain the theory of the combustion of the mercurial powder, on certain principles previously laid down in the investigation. The hydrogen, he says, of the oxalic acid and of the ætherized gas is first united to the oxygen of the